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Valuation, Capital Structure, and Shareholder Unanimity for Depository Financial Intermediaries

C. W. SEALEY, JR*

ABSTRACT

The theory of corporate finance is not directly applicable to financial intermediary decision-making. The lack of applicability stems largely from the particular conditions that distinguish intermediary operations from those of the nonfinancial firm. First, when intermediaries accept deposit financing, they must produce services such as liquidity and convenience at considerable expense for real resources. Second, the introduction of intermediation is likely to be accompanied by incomplete markets so that shareholder unanimity is not in general valid. In this paper, a model with incomplete markets is developed and a shareholder approved rule for intermediary capital structure decisions is derived.

THE THEORY OF CORPORATE finance under conditions of perfect capital markets is well developed. This theory puts forward a number of widely known theorems to deal with problems of valuation, capital structure, and shareholder unanimity. Unfortunately, this theory is applicable only to the nonfinancial firm; depository financial intermediaries (as well as other financial intermediaries) are essentially excluded since it is widely recognized that these firms can exist only in imperfect markets.

Although the theory of corporate finance has been extended to deal with some market imperfections, e.g., bankruptcy, agency problems, imperfect information, etc., the theory remains largely inapplicable to the depository financial intermediary (hereafter referred to as depository intermediary or intermediary). There are two principal reasons for this lack of applicability. First, models used to derive rules for corporate financial decisions are based on assumptions about investor behavior that exclude liquidity considerations. Since a large part of the services provided to the public by a depository intermediary is in the form of liquidity services, any model that ignores liquidity cannot adequately deal with this type of intermediary.

Second, finance theory to date does not integrate production and financial decision-making in a way that is applicable to depository intermediaries. There are a number of models attempting to integrate financial and production decisions of the nonfinancial firm but none applies to the unique production conditions

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facing the depository intermediary. When an intermediary obtains deposit financing, the deposits must be serviced at considerable expense for real resources and, moreover, the intermediary agrees to pay a large part of its deposit debt on demand. Thus, the level of deposit financing is stochastic. The result is that financial structure decisions of intermediaries present simultaneous production and liquidity implications, a situation not often encountered in nonfinancial firms.[1]

Because of the above complications, the principal issues addressed in the field of corporate finance, such as valuation, capital structure, and shareholder unanimity, have been dealt with only on a cursory level in the literature on financial intermediation. A rigorous treatment of these issues as they apply to financial intermediaries requires a more complete analysis in two respects. First, intermediary valuation must be considered in the context of capital market equilibrium where the existence of intermediaries is explicitly assumed. Such an equilibrium is important since intermediaries should play a role in determining the properties of the equilibrium thus affecting intermediary valuation. Second, market incompleteness is likely to accompany the introduction of intermediation. As a result, the derivation of objective rules for intermediary decisions depends on the crucial question of shareholder unanimity, an issue not addressed in the intermediation literature.

Rather than directly addressing the issues of equilibrium valuation and shareholder unanimity, previous writers dealing with intermediaries have chosen to avoid these problems through a variety of simplifying assumptions. Unfortunately, these models lose much of their analytical power in the process. For example, Baltensperger [1], Niehans [17], and Taggart and Greenbaum [23] examine capital structure decisions of intermediaries in a risk-neutral world. Pringle [19], on the other hand, deals with capital structure decisions within a mean-variance model in which the valuation equation used is derived in the absence of explicit assumptions about intermediary existence.

The purpose of this paper is to develop a theory of capital structure decisions of financial intermediaries based on market equilibrium. To this end, a single period model of investor behavior is developed. In the model, investors may hold an array of risky assets and a risk-free asset all of which have liquidation costs. Perfectly liquid deposits (i.e., liquidation cost is zero) issued by intermediaries are also available to investors. The impetus for deposit holding is that investors face random payment flows, and deposits allow investors to economize on liquidation costs. Intermediaries, in the model, are firms that specialize in the provision of liquidity services. These firms earn a return for their shareholders by holding a homogeneous type of loan asset and can finance this asset with equity and deposits. The intermediary employs production factors (and incurs production costs) in servicing both loans and deposits. In this setting, investors choose portfolios to maximize their expected utility. The implications of the resulting equilibrium are analyzed to determine optimal capital structure policies.

[1] Numerous models of financial intermediary behavior have appeared in the literature in recent years. Few, however, analyze intermediary decisions from the point of view of capital markets. For a review of models of intermediary behavior, see Baltensperger [2].

I. The Model

A. The Intermediary's Earnings Function

Consider a perfectly competitive one-period economy with $J = \{1, \cdots, J\}$ depository financial intermediaries where the jth intermediary holds loan assets (L_j), finances these assets with initial equity (S_j^0) and a deposit-type debt (D_j), and holds no excess reserves.[2] The intermediary is assumed to pay a liquidating dividend at the end of the period, have zero probability of bankruptcy, and be exempt from taxation. At the beginning of the period, in order to service loan and deposit accounts, intermediaries hire production factors such as labor and capital. Let the resource costs incurred in servicing loans and deposits be denoted by $C_L(L_j)$ and $C_D(D_j)$ respectively, where $C_L(0) = 0$ and $C_D(0) = 0$.[3,4] These cost functions reflect a transactions technology that enables intermediaries to provide liquidity services to investors under cost conditions not available to the public.

At the beginning of the period, the intermediary has a fixed amount of previously extended loan commitments subject to the balance sheet constraint $L_j = S_j^0$. Any deposit financing represents a purely financial transaction with the proceeds distributed to shareholders. Deposits are payable on demand and are subject to an adjustment shortly after the beginning of the period. This adjustment results from the clearing of checks through the intermediary system in response to payment flows of depositors. The deposit adjustment for the jth intermediary (ΔD_j) is given by $\Delta D_j = g(D_j, \delta)$ and depends on the level of deposits and a random state of nature, δ. At the time of this adjustment, the intermediary must borrow liquidity if $\Delta D_j < 0$ and will lend if $\Delta D_j > 0$. A secondary market exists among intermediaries where liquidity is exchanged. This market is assumed to be exogenous to the economy and perfectly competitive with a borrowing/lending rate denoted by p.[5,6]

The jth intermediary's end-of-period cash flow $(\Pi_j(\psi))$ available for distribution to shareholders and depositors can be written as:

$$\Pi_j(\psi) = R_L(\gamma)L_j - C_L(L_j) - C_D(D_j) + pg(D_j, \delta) \tag{1}$$

where $R_L(\gamma)$ is the rate on loan assets, γ is a random state of nature, and ψ is the vector (δ, γ).

B. The Investor's Return Function

There are $I = \{1, \cdots, I\}$ investors in the economy where the ith investor is assumed to have an initial endowment consisting of an $\bar{\alpha}_{ij}$ share of the jth

[2] The holding of excess reserves is ignored here since the major purpose of the paper is to analyze intermediary capital structure.

[3] A more complete discussion of intermediary cost functions is presented in Sealey and Lindley [21].

[4] The deposit costs associated with servicing deposit accounts is assumed to be a function of the beginning-of-period deposit level and thus are nonrandom. This assumption is for convenience and does not change the results of the model.

[5] The secondary market for reserves can be viewed as a Federal funds market.

[6] In the following exposition, interest rates denoted by lower case letters are net returns and those denoted by upper case letters are gross returns.

intermediary's equity and $\bar{m}_i$ of a risk-free asset.[7] The investor's optimization problem is to maximize expected utility of portfolio return by allocating the initial endowment among two types of illiquid assets, equity and a risk-free asset, and liquid deposits issued by intermediaries that earn a certain rate of return R_D paid on beginning-of-period balances.[8] From the investor's point of view, all intermediary deposits are assumed to be perfect substitutes.

Immediately after the optimal portfolio is chosen, the investor experiences a random payment flow denoted by μ_i. All transactions in the economy take place through an accounting system provided by the deposit servicing activities of intermediaries. If the investor experiences a payment outflow, the payment can be made costlessly by drawing down a deposit balance, at least to the extent that the payment does not exceed the investor's deposit. When the payment exceeds the deposit, the excess must be postponed until the end of the period with a penalty of q per dollar.[9] The random payments of each investor are assumed to be small enough that the investor has a zero probability of bankruptcy.

The ith investor's optimal portfolio is chosen subject to the budget constraint

$$\bar{m}_i + \Sigma_j \bar{\alpha}_{ij} S_j = m_i + \Sigma_j \alpha_{ij} S_j + \beta_i \Sigma_j D_j \tag{2}$$

where m_i is the optimal holding of the risk-free asset, S_j is the equity value of the jth intermediary, α_{ij} is the optimal equity share in the jth intermediary, and β_i is the investor's optimal share of total deposits.

The end-of-period return on the ith investor's portfolio is given by:

$$R_i(\theta_i) = \begin{cases} R_F m_i + \Sigma_j \alpha_{ij}(\Pi_j(\psi) - R_D D_j) + R_D \beta_i \Sigma_j D_j + \mu_i & \text{if} \quad \mu_i \in Z_{1i} \\ R_F m_i + \Sigma_j \alpha_{ij}(\Pi_j(\psi) - R_D D_j) + R_D \beta_i \Sigma_j D_j & \\ \quad - q(-\mu_i - \beta_i \Sigma_j D_j) + \mu_i & \text{if} \quad \mu_i \in Z_{2i} \end{cases} \tag{3}$$

where θ_i is the vector (δ, γ, μ_i), Z_{1i} represents the states of nature where deposit holdings cover cash demands, Z_{2i} represents the states of nature where deposit holdings do not cover cash demands, and R_F is the risk-free rate of interest.

II. Valuation when Intermediary Earnings are Certain

In this section, the valuation equation for an intermediary with certain earnings is derived from capital market equilibrium. The case of certain earnings, while not realistic, is instructive and can be used to show that the valuation of an intermediary's earnings stream is quite different from that of the nonfinancial firm. Moreover, it is shown that the market value of an intermediary is *not* independent of its capital structure.

In the model specified above, uncertainty was introduced into intermediary earnings via random deposit fluctuations and a random loan rate. In this section, both are assumed to be known with certainty. Hence, although investors experi-

[7] The only equity explicitly considered in the model is intermediary equity. Nonfinancial firms could be introduced but would add no new insights into intermediary behavior.

[8] The assumption that interest is paid on beginning-of-period balances is for simplicity only. If interest is paid on end-of-period balances, the results of the model are qualitatively the same.

[9] Alternatively, the investor could liquidate securities or the risk-free asset to meet random payments and incur a transactions cost.

ence random payment flows and the associated random changes in their deposit balances, it is assumed that the distribution of deposits among intermediaries is known with certainty. Furthermore, for simplicity, assume that $g'(D_j) = 0$. Based on the above, $\Pi_j(\psi) \equiv \Pi_j$, $R_i(\theta_i) \equiv R_i(\mu_i)$, and $R_L = R_F$.[10]

The investor's objective is to maximize expected utility of portfolio return subject to the budget constraint in (2). Using the budget constraint to substitute for m_i in Equation (3), expected utility can be written as follows:

$$E[U_i(R_i(\mu_i))] = \int_{\mu_i \in Z_{1i}} U_i[R_i(\mu_i)]f_i(\mu_i)\, d\mu_i + \int_{\mu_i \in Z_{2i}} U_i[R_i(\mu_i)]f_i(\mu_i)\, d\mu_i \quad (4)$$

where U_i is a Von Neumann-Morgenstern utility function with $U_i' > 0$ and $U_i'' < 0$, and $f_i(\mu_i)$ is the ith investor's subjective distribution of cash payments.

The first-order conditions with respect to α_{ij} and β_i are:

$$R_F^{-1}\left\{\int_{\mu_i} \omega_i(\mu_i)[\Pi_j - R_D D_j]\, d\mu_i\right\} - S_j = 0 \qquad (j = 1, \cdots, J) \quad (5a)$$

and

$$R_F^{-1}\left\{\int_{\mu_i} \omega_i(\mu_i) R_D \Sigma_j D_j\, d\mu_i + \int_{\mu_i \in Z_{2i}} \omega_i(\mu_i) q \Sigma_j D_j\, d\mu_i\right\} - \Sigma_j D_j = 0 \quad (5b)$$

where

$$\omega_i(\mu_i) \equiv U_i'(R_i(\mu_i))f_i(\mu_i) \Big/ \int_{\mu_i} U_i'(R_i(\mu_i))f_i(\mu_i)\, d\mu_i$$

is the implicit price of a unit of portfolio return if state μ_i occurs. Moreover,

$$\int_{\mu_i} \omega_i(\mu_i)\, d\mu_i = 1 \quad (6)$$

To achieve equilibrium, the market determines a set of security values and a deposit rate such that (5a) and (5b) are attainable with $\Sigma_i \alpha_{ij} = 1$ $(j = 1, \cdots, J)$ and $\Sigma_i \beta_i = 1$. This equilibrium is achieved with fixed security supplies and unrestricted short sales of securities and the risk-free asset. Since intermediaries have certain earnings, their shares must earn the riskless rate. Moreover, $q \geq (R_F - R_D)$ or otherwise deposits will be dominated. It is assumed that the above equilibrium exists.

Solving (5b) for R_D and substituting into (5a) and rearranging gives the value

[10] When firms have certain earnings, the distinction between the risk-free asset and equity is ambiguous. Deposits, however, are distinct from both the risk-free asset and equity because of liquidity differences.

of the jth intermediary ($V_j \equiv S_j + D_j$) as follows:[11]

$$V_j = R_F^{-1}\left\{\Pi_j + qD_j \int_{\mu_i \in Z_{2i}} \omega_i(\mu_i)\, d\mu_i\right\} \tag{7}$$

In equilibrium, from (5b)

$$\int_{\mu_i \in Z_{2i}} \omega_i(\mu_i) q\, d\mu_i = (R_F - R_D) \tag{8}$$

Substituting (8) into (7) gives the market value of the intermediary in terms of market determined variables and model parameters and can be written as

$$V_j = R_F^{-1}\{\Pi_j + (R_F - R_D)D_j\} \tag{9}$$

From (9) it is evident that the value of a depository financial intermediary with certain earnings is the discounted value of the end-of-period operating cash flow, plus the term $(R_F - R_D)D_j$. The latter term may be viewed as a liquidity premium paid by the public for liquidity services provided by intermediaries. The premium reflects the fact that intermediaries can borrow deposit funds at a rate less than the risk-free rate. As shown in (5b), investors are willing to pay this premium because of the liquidity services provided.

After portfolio equilibrium has been reached, the effect of a small change in capital structure on the value of the jth intermediary can be analyzed by totally differentiating (9) yielding

$$dV_j = R_F^{-1}\{(\partial\Pi_j/\partial D_j)\, dD_j + (\partial\Pi_j/\partial L_j)\, dL_j + (R_F - R_D)\, dD_j\} \tag{10}$$

From Equation (10), the following statement is justified:

PROPOSITION 1: The market value of a depository financial intermediary is dependent on the capital structure of that intermediary.

Specifically, Equation (10) shows that intermediary value increases (decreases) with a substitution of deposit financing for equity financing (i.e., $dL_j = 0$) according to

$$(R_F - R_D) > (<) - \partial\Pi_j/\partial D_j \tag{11}$$

where $(\partial\Pi_j/\partial D_j) \equiv -C_D'(D_j)$ is the marginal cost of servicing deposits.

The above results point out a significant difference between financial intermediaries and nonfinancial firms, i.e., capital structure is important to valuation even in the absence of taxes.[12] In order to maximize value, (11) shows that

[11] Equation (5b) shows that the marginal cost of holding deposits for each investor is the market determined value of the liquidity premium, $(R_F - R_D)$. Investors with low cash demands may find this value too high and choose to hold no deposits. Even though some investors may hold no deposits, in a competitive economy all investors will agree on the market determined value of this premium and will prefer the same policies as deposit holders.

[12] It is possible to contrive special cases where the *M-M* theorem may be applicable. For example, suppose the intermediary sets an explicit price on liquidity services equal to the marginal cost of producing the services. If marginal cost is constant, value would be invariant to a change in capital

deposits should be substituted for equity as long as the marginal liquidity premium is greater than the marginal cost of servicing the additional deposits.

Although the relationship between value and capital structure has been pointed out by previous writers (see [1, 17, 23)]), the inapplicability of the Modigliani-Miller theorem to financial intermediaries seems to have been largely ignored to date. For exmple, Fama [12] states in a recent paper "that when banking is competitive, [banks] in principal fall under the Modigliani-Miller theorem of the irrelevance of pure financial decisions." The difference between Fama's conclusion and the results presented here is attributable to divergent views of the financial intermediary's environment. First, and most importantly, Fama ignores the fact that debt financing decisions of depository intermediaries differ fundamentally from those of nonfinancial corporations. Since depositors receive services from their deposit accounts (such as liquidity), the very act of obtaining deposit financing requires a simultaneous production decision. For nonfinancial firms, production and financing decisions are largely independent. Such independence, however, cannot be legitimately assumed for depository intermediaries. In fact, as shown above, the production of liquidity services and its relationship to deposit financing is an important consideration in valuing the cash flows of an intermediary and is the driving force in the relationship between capital structure and valuation.

Second, whereas in this paper intermediary financing is obtained through two distinct financial instruments, deposit debt and equity, Fama makes no clear distinction between financing sources. In Fama's analysis, intermediaries "simply turn over the returns on their portfolios to the depositors, less a competitively determined management fee. Banks are concerned with the fees they earn rather than the types of portfolios they provide." In his model, deposits are financial instruments that entitle the depositor to a share of the intermediary's residual earnings. It is clear from casual observation that, barring bankruptcy, the residual earnings of the intermediary accrue neither to depositors nor management but rather to shareholders. Consequently, the relevant question is whether the owners of the residual return, rather than depositors, are interested in the pure financing policies of the intermediary. From the model presented above, it is clear that investors should be concerned with financing.

III. Valuation When Intermediary Earnings are Uncertain

The assumptions presented earlier continue to hold except that intermediaries are now assumed to face random deposit adjustments, δ, and a random loan rate, $R_L(\gamma)$, with the ith investor's assessed subjective joint density $f_i(\mu_i, \delta, \gamma) \equiv f_i(\theta_i)$.

structure. Even though intermediaries frequently charge a nominal fee for check clearing, it is important to note that this fee is not a charge for liquidity provided. Rather, service charges represent a fee for the administration of the transactions mechanism and are designed to cover, at least in part, the *ex post* cost of check clearing. The fact that this is not a payment for liquidity services is easy to verify, since charges are made for the number of checks written and have no relation to the dollar amount of the checks and thus liquidity provided. Moreover, available studies show that such charges do not, in most cases, cover the cost of check clearing.

Hence, the intermediary's end-of-period earnings are uncertain and are denoted by $\Pi_j(\delta, \gamma) \equiv \Pi_j(\psi)$. The ith investor's expected utility can now be written as:

$$E\{U_i[R_i(\theta_i)]\} = \int_{\psi} \int_{\mu_i \in Z_{1i}} U_i[R_i(\theta_i)] f_i(\theta_i) \, d\theta_i + \int_{\psi} \int_{\mu_i \in Z_{2i}} U_i[R_i(\theta_i)] f_i(\theta_i) \, d\theta_i \quad (12)$$

Eliminating m_i with the budget constraint, the first-order conditions for investor optimality, with respect to α_{ij} and β_i, are

$$R_F^{-1} \left\{ \int_{\psi} \int_{\mu_i} \omega_i(\theta_i)(\Pi_j(\psi) - R_D D_j) \, d\theta_i \right\} - S_j = 0 \ (j = 1, \cdots, J) \quad (13a)$$

and

$$R_F^{-1} \left\{ \int_{\psi} \int_{\mu_i} \omega_i(\theta_i) R_D \Sigma_j D_j \, d\theta_i + \int_{\psi} \int_{\mu_i \in Z_{2i}} \omega_i(\theta_i) q \Sigma_j D_j \, d\theta_i \right\} - \Sigma_j D_j = 0 \quad (13b)$$

where

$$\omega_i(\theta_i) = U_i'[R_i(\theta_i)] f_i(\theta_i) \Big/ \int_{\psi} \int_{\mu_i} U_i'[R_i(\theta_i)] f_i(\theta_i) \, d\theta_i$$

is the implicit price of a unit of state contingent end-of-period return. As before, market equilibrium is assumed.

Combining (13a) and (13b) and simplifying, yields the value of the intermediary when earnings are stochastic:

$$V_j = R_F^{-1} \left\{ \int_{\psi} \int_{\mu_i} \omega_i(\theta_i)(\Pi_j(\psi) + (R_F - R_D) D_j) \, d\theta_i \right\} \quad (14)$$

If it is assumed that intermediary returns are stochastically independent of the cash payments of individual investors, it is possible to rewrite (14) as follows:

$$V_j = R_F^{-1} \left\{ \int_{\psi} \omega_i(\psi)(\Pi_j(\psi) + (R_F - R_D) D_j) \, d\psi \right\} \quad (15)$$

where $\omega_i(\psi) \equiv \int_{\mu_i} \omega_i(\theta_i) \, d\mu_i$ which is the ith investor's implicit price of return if state ψ occurs. Thus, the vector ψ represents the market-relevant states for intermediary valuation.

The purpose of this section is to determine the conditions under which shareholders are in agreement on intermediary capital structure policies. The notion of shareholder unanimity has been approached in the literature in two ways, *ex ante* and *ex post* unanimity. *Ex ante* unanimity refers to agreement among the original shareholders of the firm while *ex post* unanimity involves agreement among the current shareholders once portfolio equilibrium has been reached. For a model with incomplete markets, *ex post* unanimity requires that the market be spanned so that the firm's decisions do not affect investors' risk-sharing opportunities. *Ex ante* unanimity requires both the spanning condition and the so-called "competitivity" assumption where investors perceive themselves as competitive price-takers.[13] In the following discussion, only the case of *ex ante* unanimity will be treated. It is easy to show that the conditions for *ex ante* unanimity also imply *ex post* unanimity.

PROPOSITION 2: *Ex ante* shareholders unanimously agree on small changes in intermediary capital structure if (i) intermediary returns are stochastically independent of investors' random cash payments; (ii) the market is spanned with respect to the market relevant states, ψ; and (iii) the competitivity assumption is adopted. Specifically, shareholders unanimously prefer an increase (decrease) in leverage if

$$(R_F - R_D) > (<)\ C_D'(D_j) - pE_i[g'(D_j, \delta)] + \Delta_{ij} \tag{16}$$

where the RHS of (16) is the unanimously agreed upon certainty equivalent marginal cost of deposits and Δ_{ij} is a marginal risk premium.

Proof: The most widely used methodology to show unanimous shareholder approval (disapproval) of a capital structure change is to prove that the change increases (decreases) the utility of shareholders.[14] It has been shown by DeAngelo [9], however, that all preference-free unanimity theorems must ultimately rely on the argument that the new opportunity set created by the firm's decision is dominant. The opportunity set is dependent on the risk-sharing opportunities of investors, the current market value of existing return vectors, and investors' personal wealth. DeAngelo goes on to show that, if risk-sharing opportunities and current market values are unaffected by a capital structure change, then investors will evaluate the change on the basis of its effect on personal wealth. Under these circumstances, each *ex ante* shareholder unanimously agrees that the firm should maximize perceived net value.

Assumptions (i) and (ii) above ensure that the economy's risk sharing opportunities are not affected by a change in intermediary capital structure. Assumption (i) implies that investor specific risk is not present in the market returns of intermediaries. Assumption (ii) implies that, although the market is incomplete with respect to the entire state space θ_i, it is always incomplete in the same way so that the feasible state space remains invariant to a change in capital structure. Assumption (iii), coupled with the restriction that there are no technological externalities (i.e., the decisions of one firm do not effect the payoff vectors of other firms), ensures that current market values are unchanged. Thus, personal wealth increases (decreases) as intermediary value increases (decreases).

The value maximizing capital structure can be obtained by totally differentiating the valuation equation in (15) yielding

$$dV_j = R_F^{-1}\left\{\int_\psi [\omega_i(\psi)(d\Pi_j(\psi) + (R_F - R_D)\ dD_j) + d\omega_i(\psi)(\Pi_j(\psi) + (R_F - R_D)D_j)]\ d\psi\right\} \tag{17}$$

[13] A discussion of *ex post* and *ex ante* unanimity can be found in Baron [4] and DeAngelo [9].
[14] For examples of this approach, see [4, 11, 16, 22].

Assumptions (i)–(iii) imply that $d\omega_i(\psi) = 0$. After simplification, (17) becomes relation (16) where $\Delta_{ij} \equiv -\text{Cov}(\omega_i(\psi),\ g'(D_j,\ \delta))$. As a result of the spanning assumption, (17) has the same value for all investors.[15]

PROPOSITION 3: If Assumptions (i)–(iii) are not fulfilled, then shareholder agreement on capital structure changes will not in general be possible. A special case where unanimity is present irrespective of Assumptions (i)–(iii) is when deposit uncertainty is additive, i.e., $\Delta D_j = g(D_j) + \delta$.

The validity of the above statement is easy to see since $g'(D_j,\ \delta) = g'(D_j)$ when uncertainty is additive. In this case, (16) becomes

$$(R_F - R_D) > (<)\ C_D'(D_j) - pg'(D_j)$$

since $\text{Cov}(\omega_i(\psi),\ g'(D_j)) = 0$. The reason unanimity is present is that, when uncertainty is additive, a change in capital structure creates a marginal return vector that is *not* linearly independent of the already existing return vector.

The above analysis shows that, under certain circumstances, shareholders agree on capital structure changes of intermediaries. The crucial assumptions in obtaining unanimity are the stochastic independence of intermediary returns and investors' cash payments, and the spanning of the market relevant states. Based on these assumptions, the market need not be complete for unanimity to be present, i.e., the entire state space θ_i, need not be spanned.[16] Instead, only the market-relevant states, ψ, need to be spanned since investor-specific risk is not present in the market returns of intermediaries. If these conditions are not met, then unanimity will not exist in general. For the special case of additive deposit uncertainty, however, unanimous agreement on capital structure changes is possible irrespective of stochastic independence and spanning.

The conditions for unanimity may not be as restrictive as they first appear. It has been shown by Satterthwaite [20] that spanning of the market-relevant states is an equilibrium consequence of the market process, otherwise arbitrage opportunities exist. The assumption of stochastic independence is a somewhat more bothersome restriction. Clearly, if an intermediary has only one customer, the assumption will be violated. When intermediaries have large numbers of customers, however, much if not all of this correlation is likely to be diversified away. When one investor makes a payment by drawing down a deposit balance, another investor receives the payment, thus augmenting a second deposit balance at either the same or another intermediary. In fact, if there is no currency drain from the banking system, deposit variations of intermediaries result exclusively from the redistribution of deposit balances among intermediaries. If intermediaries have large numbers of customers (and casual observation indicates that they do) and there is nothing systematic about the distribution of customers among intermediaries, there is no reason to believe that any specific relationship will exist between cash payments of investors and intermediary deposit flows. At the extreme, with completely costless diversification, all deposit fluctuations can

[15] The same results are obtainable using the utility maximizing proof.

[16] Unanimity would of course be present irrespective of stochastic independence if the entire state space, θ_i were spanned, i.e., if the market were complete. In this case, however, there would be no need for intermediaries.

be eliminated if the intermediary holds equal proportions of each investor's deposit balance. Of course, intermediaries do not diversify to such an extent so that the possiblity of some degree of correlation is always possible. The strength of this correlation is ultimately an empirical matter.

It is also interesting to note the implications of the preceding analysis for observed capital structure decisions of financial intermediaries. Casual observation indicates that depository intermediaries tend to have very high and increasing leverage ratios. For example, in the U.S., large money market banks have deposit/equity ratios as high as 30 to 1 and Canadian banks currently range as high as 33 to 1. Numerous explanations have been given for this phenomenon, most of which rely on the effects of regulation. For example, it is argued by Peltzman [18], Buser, Chen, and Kane [6] and Dwyer [10] that banks have substituted deposit insurance for equity, hence accounting for increased leverage since the 1930s.

Although this argument may have some validity, two reservations should be kept in mind. First, the empirical verification of this hypothesis is by no means settled. Peltzman and Dwyer present evidence in support of the hypothesis but Throop's [24] estimates do not confirm the hypothesis. The model developed by Throop has perhaps more intuitive appeal since it is based on competitive capital markets whereas Peltzman and Dwyer assume a less than perfectly elastic supply of capital to the banking industry, an assumption that has no justification in an efficient market.

Second, although leverage in banking has been gradually increasing since the implementation of deposit insurance 50 years ago, banks were heavily levered prior to the 1930s. In fact, banks were so heavily levered during the 19th century that the U.S. government first enacted minimum capital standards in the National Banking Acts of 1863–64. Certainly it cannot be argued that regulation was the cause of high leverage in the last century.

The results of this paper suggest an alternative hypothesis that relies on more fundamental aspects of intermediary operations and is consistent with high leverage before and after the implementation of deposit insurance as well as the trend towards higher leverage. Condition (16) implies that intermediaries with substantial economies of scale in servicing deposits may choose a capital structure with high leverage. The existence of economies of scale has been verified in numerous empirical studies (see, e.g. [5]). Since the 1930s, banking technology has certainly advanced and these technological advances could be equally important in explaining the trend towards higher leverage. Perhaps empirical investigation in this direction will be more successful in explaining bank leverage than studies appearing to date.

IV. Mean-Variance Valuation of Depository Financial Intermediaries

The model developed in previous sections is based on very general assumptions about investor preferences and expectations. Unfortunately, such general assumptions do not allow the derivation of an operational valuation equation. It is possible, however, to give operational meaning to the model within a mean-variance framework.

In order to derive the mean-variance analogue of the valuation equation in (15), it is necessary to depart from the earlier model in several respects. Obviously, the first departure is to assume investors possess nonsatiated, risk-averse, mean-variance utility functions. Second, investors are assumed to have homogeneous expectations concerning the joint normal distribution of the firm specific variables δ_j and γ_j. Finally, it is necessary to assume that R_D is given at its equilibrium value since an explicit solution for the deposit rate is not obtainable from the mean-variance model. The remaining assumptions such as fixed security and deposit supplies and utility maximizing investors remain as before. It is no longer necessary to assume that intermediary returns are independent of investors' cash payments.

Proceeding in the manner normally employed to derive the CAPM, the mean-variance valuation equation for the jth financial intermediary is[17]

$$V_j = R_F^{-1}\{E(\Pi_j) + (R_F - R_D)D_j - \lambda[\mathrm{Cov}(\Pi_j, \Pi_m) - \mathrm{Cov}(\Phi, \Pi_j)]\} \qquad (18)$$

where $\Pi_m \equiv \Sigma_j\Pi_j$, $\Phi \equiv \Sigma_i\phi_i$ and

$$\lambda \equiv \frac{E(\Pi_m) - R_F V_m + (R_F - R_D)D_m}{\mathrm{Var}(\Pi_m) - \mathrm{Cov}(\Phi, \Pi_m)}$$

Equation (18) gives the value of a financial intermediary in a mean-variance world. The significant aspect of (18) is that the certainty equivalent cash flow is somewhat different from the CAPM without intermediation. First, the liquidity premium $(R_F - R_D)D_j$ is added to the intermediary's operating cash flow. Second, the market price of risk includes the market liquidity premium $(R_F - R_D)D_m$. Finally, the risk of the jth intermediary, or any other firm for that matter, is the covariance of the operating cash flow with the market minus the covariance of the cash flow with the total payments of investors.[18] The measure of risk in (18) is similar to that derived by Chen, Kim, and Kon [8] (CKK) who consider random cash payments without intermediation. CKK refer to $\mathrm{Cov}(\Phi, \Pi_j)$ as the external liquidity services provided by the jth firm's cash flows. The sign of this term may be either positive, negative, or zero thus decreasing, increasing, or leaving unchanged the systematic risk of the firm.

[17] Expected end-of-period return is obtained by substituting (2) into (3) to eliminate m_i and taking the expectation:

$$E[R_i(\theta_i)] = R_F m_i + R_F(\Sigma_j\alpha_{ij} - \alpha_{ij})S_j - (R_F - R_D)\beta_i\Sigma_j D_j + \Sigma_j\alpha_{ij}(E(\Pi_j) - R_D D_j) - E(\phi_i)$$

where

$$\phi_i = \begin{cases} 0 & \text{if } \mu_i \in Z_{1i} \\ q(-\mu_i - \beta_i\Sigma_j D_j) & \text{if } \mu_i \in Z_{2i} \end{cases}$$

and

$$\Pi_j \equiv \Pi(\delta_j, \gamma_j)$$

The variance of return is

$$V_i[R_i(\theta_i)] = \Sigma_j\Sigma_k\alpha_{ij}\alpha_{ik}\mathrm{Cov}(\Pi_j, \Pi_k) + V(\phi_i) - 2\Sigma_j\alpha_{ij}\mathrm{Cov}(\phi_i, \Pi_j)$$

[18] In an economy with no exogenous payment flows, $\Phi \equiv \Sigma_i\phi_i = 0$ so that $\mathrm{Cov}(\Phi, \Pi_j) = 0$.

It has been argued elsewhere, e.g., by Ekern and Wilson [11], that shareholders may unanimously agree that the firm *not* maximize value in a mean-variance world. DeAngelo [9] and Hart [13] show, however, that shareholders will prefer a firm to maximize its net market value if sufficient assumptions are made to ensure that each firm is a perfect competitor. If value maximization is consistent with shareholders wishes, then shareholders will prefer an increase (decrease) in leverage if

$$(R_F - R_D) > (<)\ C'_D(D_j) - pE[g'(D_j,\ \delta_j)] + \lambda[\mathrm{Cov}(g'(D_j,\ \delta_j),\ \Pi_m) - \mathrm{Cov}(g'(D_j,\ \delta_j),\ \Phi)] \quad (19)$$

Relation (19) has the same interpretation as (16). In comparison to (16), however, the marginal risk premium now has an explicit form and represents the marginal change in total systematic risk of the intermediary given a change in capital structure. As before, intermediary capital structure is determined by the tradeoff between the marginal liquidity premium and the marginal risk-adjusted cost of deposits.

The importance of the valuation equation (18) can be seen by comparing its implications with previous studies that have employed the CAPM to value depository intermediaries. Chateau [7], Folkerts-Landau [14], and Pringle [19], for example, consider value-maximizing policies of intermediaries using the CAPM to value the intermediary. None employs, however, a version of the CAPM derived in the presence of intermediation and the accompanying liquidity considerations. Thus, their models omit the liquidity premium and imply different optimal decisions for the intermediary. Moreover, none can relate high leverage to economies of scale in deposit servicing.

V. Implications and Conclusions

In this paper, a model of the depository financial intermediary has been developed. The impetus for the existence of intermediaries is the demand for liquidity services by investors. Depository intermediaries produce such liquidity services, and investors are willing to pay a premium for liquidity since a penalty cost is incurred for being illiquid. The model has the following theoretical and empirical implications.

First, the valuation equation of a financial intermediary is not the same as that of a nonfinancial firm. The difference is accounted for by a liquidity premium paid by the public in exchange for liquidity services. Moreover, it was shown that capital structure decisions are not, in general, a matter of indifference to shareholders of intermediaries. Next, several important theorems were developed showing the conditions under which an appropriate objective function for capital structure decisions of a shareholder-owned intermediary can be formulated. These theorems show that unanimity is possible if intermediary returns are stochastically independent of investors' payment flows and the market is spanned with respect to the market-relevant states. Finally, the mean-variance implications of the model were explored.

Second, the results have a number of interesting implications for observed capital structure decisions of intermediaries. Historically, financial intermediaries have been the most heavily levered firms in the economy yet there are few rigorous examinations for this phenemenon. Most explanations rely on the effects of government regulation which begs the issue, since high leverage characterized the banking industry long before the implementation of any significant degree of banking regulation. The model presented in this paper provides a more fundamental explanation of leverage based on technological conditions that govern the production of intermediary services. If substantial economies of scale exist in the production of deposit services, then high leverage decisions by intermediary management may be justified as maximizing shareholder utility. An investigation of the relationship between leverage and economies of scale may provide better insights into the leverage decisions of intermediaries than models available to date.

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